



Translation

PRESSURE VESSELS IN NUCLEAR FACILITIES.
GENERAL GUIDELINES ON REGULATION

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1 GENERAL

This guide shows in outline how the Decrees on Nuclear Energy and on Pressure Vessels are applied to the design, manufacture, quality control, inspections and operation of pressure vessels in nuclear facilities. Detailed requirements are given in other YVL Guides and standards, to which reference is made in this guide. In case of discrepancies between this guide and a more detailed YVL Guide, the guide that has come into force later shall be complied with.

The general safety criteria that are to be followed in the design of nuclear facilities have been presented in Guide YVL 1.0. The regulation of pressure vessels forms a part of the supervision of the safety of nuclear facilities, which is described as a whole in Guide YVL 1.1.

1.1 Regulatory authority

The Finnish Centre for Radiation and Nuclear Safety (STUK) acts as the regulatory authority of pressure vessels in nuclear facilities. However, transportable gas containers and pressure vessels which are used exclusively for maintenance purposes during the construction of a nuclear facility or by the personnel are regulated by the Technical Inspection Centre (TTK).

1.2 Scope

This guide applies to all pressure vessels in nuclear facilities, excluding those regulated by the Technical Inspection Centre as explained in section 1.1. The regulations of this guide are also applied to the internals of reactor pressure vessels and to steel containments, including the related penetrations. Guides for certain pressure-bearing structures and components, such as

pumps, valves, electrical and instrumentation equipment, and reactor containments made of reinforced concrete, are issued separately by STUK. This guide is not applicable to pressure vessels in Class EYT that have been left outside regulation pursuant to a guide or decision given by STUK.

Pressure vessels that have been manufactured before the guide came into force are regulated in accordance with this guide. For well-grounded reasons it can be agreed that a previous practice is continued when making modifications to a plant that is in use. However, this guide is followed when new independent facilities are being designed and built.

As a rule, this guide is followed when dealing with pressure vessels that are imported to Finland. Some other guides in YVL Guide Series 3 provide detailed directions.

Besides the SFS Standards mentioned here, the Finnish Centre for Radiation and Nuclear Safety can accept some other applicable Finnish or foreign standard for use.

1.3 Licenses and inspections

The following is a list of the licensing and inspection procedures relating to the design, manufacture, quality control, inspection and operation of pressure vessels in nuclear facilities. The relevant section number is given in parentheses.

General licenses and approvals

- construction permit of a nuclear facility (2)
- approval of the technical requirement level of quality control (2, 5.1)

- manufacturing license and approval of the supervisor of manufacture (3.1, 3.2)
- approval of testing companies and testers (3.3, 5.3, 8.1.2)
- general approval of construction materials (4)
- issuance of construction inspection licenses (6.3)
- supervisor of operation (6.5)
- review of a nuclear facility (7)
- operating license of a nuclear facility (7)
- general licenses and descriptions of outages (8.2.1)
- licenses for repairs and modifications during operation (8.3)

Pressure vessel-specific licenses, inspections and control before the commissioning of a nuclear facility

- inspection of the construction plan (6.1)
- inspection of stress analyses (6.1)
- inspection of the location plan (6.2)
- supervision of manufacture and competence of welders (5.2)
- construction inspection (6.3)
- installation (6.3.6)
- commissioning inspection (6.4)
- preservice examinations (6.6)

Supervision and inspections during operation

- periodic inspections of pressure vessels (8.1.1)
- inservice inspections as per Guide YVL 3.8 (8.1.2)
- supervision and inspections of outages (8.2)
- inspections of repairs and modifications during operation (8.3)

1.4 Definitions

The following definitions are used in this guide.

Nuclear facility means plants, including research reactors, used for producing nuclear energy, plants engaged in extensive final disposal of nuclear waste, and plants used for extensive processing or storing of nuclear material and nuclear waste.

Pressure vessel means a pressure tank, piping or other component (cf. scope 1.2) which has or can develop a pressure higher than that of the atmosphere.

Pressure means over-pressure; the unit of pressure is megapascal (MPa).

Pressure tank means a pressure vessel other than a steam boiler or piping. The internals and supporting structures are also included in the pressure tank. Distributing and collecting chambers not provided with shut-off valves belong to the piping.

Piping means any external network of pipes, or pipeline, attached to a pressure tank. The piping also includes pipelines leading to a non-pressure tank or space or to surface or ground waters.

The design and inspection limit between the pressure tank and the piping is

- the first transverse welded or threaded joint in a pipe coming from the pressure tank, with the exception of a joint that connects the pipe to the pressure frame.
- the sealing surface of the first flanged joint.

A welded seam that forms a design limit is included in the piping.

In dimensioning the supports of the pressure vessel, the design limit is the first welded or threaded joint in a support or lug that has been fixed to the pressure vessel. A welded seam that forms a design limit is included in the pressure vessel.

Safety class is determined on the basis of the safety classification document for systems, structures and components. The document is prepared in accordance with Guide YVL 2.1 and approved by STUK.

Records mean a compilation of documents and certificates prepared, arranged and filed as agreed upon with STUK. It includes the documents, inspection reports and other results and samples that describe the plans, approvals, inspections and other actions concerning the pressure vessel.

1.5 List of pressure vessels

All pressure tanks of a nuclear facility shall be listed according to their systems. The list contains the following information of the pressure tank: symbol, name, safety classes of various parts, design pressure, design temperature, volume and contents.

The piping of each system shall be listed correspondingly, giving the safety class, design temperature and design pressure of the piping, as well as the nominal sizes or dimensions of the pipes. The list can be replaced by writing the corresponding data to the flow and instrumentation sheets of the classification document.

The list of pressure vessels forms a part of the component

list required in the safety classification document. The list of pressure vessels shall indicate the scope of the construction and inservice inspections performed by STUK. The power company is under an obligation to keep the list of pressure vessels up-to-date.

1.6 Pressure vessels containing dangerous substances

If a pressure vessel contains a dangerous liquid or gas or other dangerous substances, the provisions of the relevant legislation shall be complied with - in addition to the regulations set forth in this guide. As stipulated by Guide YVL 2.1, the quality requirements of a pressure tank in a system belonging to Class EYT are determined according to Safety Class 3 if the tank contains a dangerous substance. The requirements of the piping connected to these pressure tanks can be determined according to Class EYT.

Examples of dangerous contents include:

- combustible liquids and gases, such as petrol, carbon disulphide, hydrogen, hydrocarbon and ammonia
- substances heated to a temperature which is at least 25°C higher than their flash point
- first-class poisons and certain second-class poisons, such as sulphuric acid
- oxygen, if the pressure vessel is so located that a leak or an explosion adds to the direct fire risk.

2 CONSTRUCTION PERMIT OF A NUCLEAR FACILITY

The regulation of a nuclear facility can be divided into three phases. The first of these ends with the issuance of the construction permit, the second ends with the

issuance of the operating license and the third begins with the issuance of the operating license.

Before granting the construction permit for a nuclear facility, the Ministry of Trade and Industry asks for the opinion of the Finnish Centre for Radiation and Nuclear Safety. In its statement, STUK proposes that the license should include certain conditions and directions, which are necessary for ensuring safety. For preparing the statement, STUK needs normally about one year.

The application for a construction permit is supplemented with separate reports, of which at least the following are associated with pressure vessel regulation.

Preliminary Safety Analysis Report (PSAR)

The document (defined in more detail in Guide YVL 1.1) contains the data on the general design and implementation principles and a description of the most important systems and components of the plant. It also includes general plans for the location of pressure tanks and piping, as well as the descriptions of the principles of inservice inspection, which are required in Guide YVL 3.8.

Safety classification document

The pressure vessels of a nuclear facility are grouped into safety classes on the basis of their safety significance (YVL 2.1). Pressure vessels important to safety (Safety Classes 1, 2 and 3) and the pressure vessels belonging to Class EYT shall be designed, manufactured and installed in such a way that their standard of quality and the inspections and tests needed for

verifying it are commensurate with the safety significance of the pressure vessel. STUK also uses the safety classification for defining in more detail the scopes and types of inspection listed in section 6.

In addition, the classification document can introduce an inspection classification for structures and components and make reference to the standards and other guides that are to be applied in the implementation. It can be further mentioned in the document which components will be subjected to a stress analysis as per Guide YVL 3.5. The safety classification of piping is shown in the diagrams depicting the fluid systems.

The document describing the technical requirement level of quality control (section 5.1), which concerns the design of components important to safety, can also be submitted to STUK for review in this connection.

Topical reports

The purpose of these reports is to show in detail on which empirical studies and theoretical analyses the plant design is based. Topical reports shall be submitted e.g. on the reactor, on the reactor pressure vessel and on the containment.

Quality assurance programs

The quality assurance principles defined in Guide YVL 1.4 are applied to the activities affecting the quality of the pressure vessels

that are important to the safety of a nuclear facility (Safety Classes 1, 2 and 3) to the extent required by the safety significance of the pressure vessel. Especially those organizations whose work has a direct effect on the design, manufacture, quality control and inspections of pressure vessels in Safety Classes 1 and 2, shall have separate quality assurance programs defining their activities.

3 MANUFACTURER

This section describes which activities relating to the manufacture and quality control of a pressure vessel require a license.

3.1 Manufacturing license

Pressure vessels that will be used in nuclear facilities in Finland may be manufactured only on a license issued by the competent regulatory authority. The manufacturing license for pressure vessels in Safety Classes 1 or 2 shall be issued by STUK. Pressure vessels in Safety Class 3 and in Class EYT can be manufactured on a license issued either by the Technical Inspection Centre (TTK) or STUK.

The application procedures, the requirements to be met, and the updating of the information forming the basis of a valid license are described in Guide YVL 3.4. Said guide also includes instructions for manufacture which takes place abroad or on a license issued by TTK.

3.2 Supervisor of manufacture

A prerequisite for the issuance and continued validity of a manufacturing license is that the pressure vessel is

manufactured under the surveillance of a supervisor of manufacture approved as per Guide YVL 3.4. That guide describes the approval procedures, competence requirements and duties of a supervisor of manufacture in more detail.

3.3 Approval of testing companies and testers

Only those testing companies and testers that have been specifically approved by STUK for that kind of work can act as testers and specialists of nuclear power plant structures and components during the construction of a nuclear facility. The application for a license to a company or to an individual tester is made as per Guide YVL 1.3. If the manufacturer tests only his own products, the application for licensing the manufacturer's quality control department and its testers can be filed simultaneously with the application for a manufacturing license.

4 CONSTRUCTION MATERIALS

Only approved construction materials and welding filler materials may be used for the manufacture of pressure vessels in nuclear facilities. The approval has two phases: the general approval of a material for pressure vessels in nuclear facilities and the component-specific approval of the selection of material in connection with the construction plan.

The component-specific approval of a material requires a valid general approval of the material as a construction material for pressure vessels. It shall be possible to demonstrate the applicability of the materials to their intended uses on the basis of a standard or other such document.

The approval procedure for the construction materials of pressure vessels is dealt with in Guide YVL 3.9.

5 DESIGN, MANUFACTURE AND QUALITY CONTROL

5.1 Design

Pressure vessels shall be designed so as to meet the criteria set forth for the design, stress analysis, materials, manufacturing methods and inspections of pressure tanks and piping (Guides YVL 3.1, 3.2, 3.3, 3.5, 3.8 and 3.9).

The design criteria for pressure vessels in Safety Classes 1, 2 and 3, for example the technical requirement level of quality control and the scope of inspections, are not dealt with in detail in YVL Guides or in standards. Therefore it is appropriate, for each nuclear facility to be constructed, to draw up a unit-specific document describing the design and quality control criteria. This should be submitted to STUK for approval before the component-specific construction plans. STUK reserves about six months for reviewing the document.

5.2 Manufacture

Pressure vessels shall be manufactured under the supervision of an approved supervisor of manufacture following the construction plan, accepted by STUK, and the provisions of the manufacturing license.

Pressure vessels are welded in accordance with the SFS Standards (SFS 2218, SFS 2223), unless STUK has accepted some other procedure when reviewing the construction plan. The welding of a pressure vessel in Safety Class 1 or 2 shall be based on procedure tests that have been completed before the manufacture is begun (Guide YVL 3.1). When parts are welded to the pressure frame, the requirements to be followed are the same as in the welding of pressure-bearing parts.

The pressure vessel shall undergo heat treatment in conformity with SFS Standards or guides accepted in connection with the construction plan. If it is intended that the pressure vessel be subjected to heat treatment subsequent to welding, repair welding after the heat treatment is allowed only on condition that a repair plan accepted by STUK is followed in the work.

STUK supervises the manufacture in the various phases of manufacture and installation in accordance with Guide YVL 3.6, depending on the safety class and importance of the component in question. As concerns pressure vessels in Safety Classes 1 and 2, STUK shall be notified when their manufacture is begun and how the work is proceeding.

By supervising the manufacture, the regulatory authority ensures that the requirements in the various resolutions and guides are met and that the pressure vessels of a nuclear facility are made to an acceptable quality.

In making agreements on procurement, the power company must especially pay attention to the fact that it has a duty to ensure the authorities' rights to supervise the manufacture of pressure vessels.

5.3 Quality control

Quality control shall take place according to the quality control programs and inspection instructions, as well as the design documents and material requirements concerning manufacture, which STUK has accepted as part of the construction plan.

The quality control organizations that make tests shall be independent of the manufacture and accepted in conformity with Guide YVL 1.3 (section 3.3).

Quality control inspections and tests during manufacture shall be timed so that the quality of the completed structure can be reliably shown on the basis of the inspection results.

The manufacture and installation of pressure vessels in Safety Classes 1 and 2 shall be controlled by an approved testing company that is independent of the manufacturer and his inspection organization. Correspondingly, the testing company (organization) shall perform or verify the tests that are associated with quality control. The control plan can be included in the quality control program.

If the quality control reveals substantial deviations from the acceptance limit defined by the quality control program or the standards, a deviation report is written. The deviation report includes a description of the deviation, an account of its reasons and the necessary action or repair plan, and it is submitted to STUK for approval following the same procedure as in the case of the construction plan.

6 INSPECTIONS

This section deals with the inspections carried out by the regulatory authority before the pressure vessel is placed in service.

6.1 Inspection of the construction plan

6.1.1 General

The pressure vessel is provided with a construction plan, which shall be accepted by STUK before the manufacture is begun. For the inspection, the holder of the construction

license of a nuclear facility (the power company) shall submit the construction plan to STUK in three copies, in accordance with the principles of Guide YVL 1.2. In the inspection of the construction plan, it is examined how the pressure vessel meets the requirements in this guide. If the safe operation of the pressure vessel makes it necessary to determine certain conditions and requirements for its structure and inspections, they are also determined in this connection. Attention is paid to such factors as design criteria, selection of materials, strength calculations, manufacturing processes, quality control programs, and accessibility to inservice inspections.

The pressure vessel undergoes a stress analysis in accordance with Guide YVL 3.5 and in the cases required by said guide. The stress analysis shall be accepted by STUK before the plant is commissioned. Preliminary stress analyses can be accepted at this stage as far as more accurate analyses require additional data on the various operational states of the plant.

6.1.2 Pressure tanks

Pressure tanks in Safety Classes 1 and 2, or their parts, shall be provided with a construction plan conforming to Guide YVL 3.1, and pressure tanks in Safety Class 3 or Class EYT with a construction plan conforming to Guide YVL 3.2.

6.1.3 Piping

As stipulated in Guide YVL 3.3, the construction plans are submitted for approval as design entities specified according to their safety classes.

In the case of piping in Safety Class 3 and in Group EYT/A, a so-called piping specification can be submitted

to the authorities for approval. When necessary, the specification will act as a basis for the construction plan. The parts of piping in Group EYT/A need not have STUK's approval for the construction plan, if the piping specification has been approved. The piping in Safety Class 3 must have STUK's approval for the construction plan, unless the piping specification is unequivocal enough even in all individual cases.

The parts of piping in Group EYT/B need not have the construction plan or the piping specification approved by STUK.

6.2 Inspection of general location plans

The general location plans of pressure vessels are inspected as part of the reviews of the Preliminary and Final Safety Analysis Reports mentioned in Guide YVL 1.1. The Safety Analysis Report shall include the general data concerning the location of the pressure vessels, as well as the location drawings. No vessel-specific decisions are made on the basis of the inspection.

Whenever applicable, the location of a pressure vessel shall meet the requirements in SFS Standards (e.g. SFS 3323 and SFS 3333). In addition, attention shall be paid to accessibility, required by the inservice inspections as per Guide YVL 3.8, and to the general requirements on radiation protection.

6.3 Construction inspection

6.3.1 General requirements

The pressure vessel is subjected to a construction inspection, which comprises the inspection of the implementation of the construction plan, the inspection of the work qua-

lity, the pressure test, and the review of the quality control documents. The construction inspection is dealt with in Guide YVL 1.15.

The inspection request is delivered to STUK in accordance with Guide YVL 1.2. The request shall be made early enough so that the inspection can be carried out at the manufacturing site, or in the case of prefabricated piping, at least prior to installation. If a structural part in the pressure vessel becomes less accessible as the manufacture is progressing, a partial construction inspection is performed before the manufacture is continued.

The construction inspection is carried out according to Standard SFS 3270, where applicable. A record is always drawn up of a completed inspection.

When the pressure vessel has been accepted in a construction inspection, the inspector stamps STUK's emblem and his own initials on the pressure frame and, when necessary, on unattached parts and on the nameplate, after he has ascertained that the identification data conform to the regulations and the construction plan.

In the construction inspection, an inspector of STUK has the right to accept minor deviations concerning the construction plans, manufacture and inspections.

If the inspector considers it necessary to repair the pressure vessel or to perform supplementary inspections, he must bring forward in writing what sort of additional investigations are required. The pressure vessel can be accepted if the result of the supplementary inspections or tests is acceptable. Otherwise the pressure vessel must be repaired or rejected.

6.3.2 Pressure tanks in Safety Classes 1, 2 and 3

The construction inspection of pressure tanks in Safety Classes 1, 2 and 3 is performed by an inspector employed by STUK, in accordance with subsection 6.3.1.

6.3.3 Pressure tanks in Class EYT

The construction inspection is performed by an inspector employed or approved by STUK, in accordance with subsection 6.3.1. However, in the case of a pressure tank that is imported to Finland, it can be agreed that the construction inspection is partially compensated with the following inspections performed in the manufacturing country: supervision of the welders' competence by an inspector who has been accepted for this purpose in the manufacturing country; the visual inspection of those parts of the pressure tank that have become less accessible as the tank has been completed; and in special cases the pressure test. An acceptable certificate shall be presented of the inspections. Other prerequisites for acceptance are that the inspections have been carried out in accordance with a guide issued or approved by STUK, that they have been based on a construction plan accepted by STUK, and that there exists no essential reason for repeating the inspection.

6.3.4 Piping

The construction inspection of piping is performed by an inspector employed or approved by STUK, in accordance with Guide YVL 3.3.

6.3.5 Records

The manufacturer or importer of a pressure vessel shall compile the documents and other material concerning the

pressure vessel and give them to the power company after the construction inspection. The power company shall store the documents (samples, when necessary) carefully and protect them against damage for as long as the pressure vessel is in use. The document files shall be available to STUK.

6.3.6 Installation

The installation of the pressure tank to its place of operation can be begun after the tank has passed the construction inspection. If the pressure vessel has become damaged during the transport, it must be re-inspected before the installation. If the pressure vessel has failed the construction inspection because of some far-reaching defects of a basic nature, it is possible to apply to STUK for a separate installation permit before the construction inspection is finally accepted.

6.4 Commissioning inspection

A pressure vessel may not be placed in service until it has been accepted in a commissioning inspection. The commissioning inspection is carried out by an inspector of STUK. However, the pressure vessel can be used before the commissioning inspection in connection with the start-up testing of the system, as specified in Guide YVL 2.5.

In the commissioning inspection, which takes place after the installation of the pressure vessel, it is ascertained that the pressure vessel has been accepted in a construction inspection, that it has the necessary accessories and that the conditions set forth in the inspections have been fulfilled. The commissioning inspections of accessories that have been attached directly to the pressure frame of the vessel are as a rule carried out in

connection with the commissioning inspection of the pressure vessel (e.g. water level devices, pressure and temperature gauges). The performance tests of other accessories (valves) are usually performed separately as part of the start-up testing.

The documents describing the pressure vessel also contain lists of the accessories of the pressure vessel, including the data on their structure, and the results of the necessary performance tests of the accessories (e.g. testing of a safety valve).

A commissioning inspection is carried out in accordance with Guide YVL 3.7.

STUK does not perform any commissioning inspections for piping in Group EYT/B. However, the power company must ensure the operability of this piping before the commissioning of the plant, for instance in the same way as in the case of piping of Group EYT/A.

6.5 Supervision and supervisor of operation

The power company shall be able to hire personnel that has expert knowledge of the structure, operation and maintenance of pressure vessels. The power company is responsible for the safe operation and proper maintenance of its pressure vessels.

Among the plant organization, the power company must appoint an expert person to act as the supervisor of pressure vessel operation. STUK shall be provided with the data on the supervisor of operation and his deputy. The person who is appointed will supervise the operation and condition of pressure vessels and he is responsible for contacts to STUK in matters concerning supervision and inspection. The supervisor must additionally see to

it that the inservice inspections of pressure vessels can be performed at pre-set times and that adequate reports are compiled of all actions and inspections carried out during operation.

6.6 Preservice examinations

Before the commissioning of a nuclear facility, STUK reviews the summary and preservice examination programs of inservice inspections and accepts the results of preservice examinations.

The preservice examination program shall be submitted to STUK for approval not later than three months before the planned date of inspection (Guide YVL 3.8). When the examinations have been completed, STUK is provided with a written notification, which gives account of any fault indications exceeding the acceptance limits and of the actions necessitated by these indications. The results of the preservice examinations with their summary reports shall be submitted for approval early enough before the review of the nuclear facility.

7 OPERATING LICENSE OF A NUCLEAR FACILITY

Before granting the operating license to a nuclear facility, the Ministry of Trade and Industry asks for the opinion of the Finnish Centre for Radiation and Nuclear Safety. When preparing its statement, STUK ensures that the documents mentioned in Guide YVL 1.1 have been accepted. Of these documents, the following relate to pressure vessel control:

- the Final Safety Analysis Report
- the final topical reports
- stress analyses of pressure vessels
- summary programs of inservice inspections

- the quality assurance program for operation.

Review

The operating license cannot be issued before STUK has prepared a protocol of the review. As concerns pressure vessels, it is required that

- the preservice examinations have been completed and the results accepted
- all commissioning inspections have been completed and the pressure vessels have been accepted for use
- the preliminary technical specifications have been accepted.

8 OPERATION

The Finnish Centre for Radiation and Nuclear Safety supervises the operation of pressure vessels in nuclear facilities by reviewing documents and by conducting inspections and audits.

8.1 Inservice inspections

The purpose of the inservice inspections is to ascertain the condition, reliability and safe operation of the pressure vessel.

If the inspection reveals that the pressure vessel contains faults or deficiencies that impair the safety of its use, STUK can determine new operating parameters for the pressure vessel or forbid its use.

8.1.1 Periodic pressure vessel inspections

The periodic inspections that are applied to a pressure

vessel in service are: overall inspection, inspection of the inside, and inspection of operation. Standards SFS 3334 and SFS 3321 are followed in the inspections, where applicable. The periodic inspections of piping are determined according to Guide YVL 3.3. The above-mentioned inspections are performed by STUK. The inspection of operation and the inspection of the inside, or the substituting non-destructive examinations, are made every four years. The overall inspection, which includes the above inspections and a pressure test, is performed every eight years. The times of the inspections are written in the record that is kept of the inspection. In individual cases, and for well-founded reasons, it is possible to deviate from the above-mentioned intervals of inspection.

8.1.2 Inservice inspections as per Guide YVL 3.8

Pressure vessels, piping and their supporting structures in Safety Classes 1 and 2, as well as the internals of the reactor pressure vessel, shall be subjected to inspections that are made with non-destructive examination methods and repeated periodically. These inspections mean inservice inspections that are performed during the shutdowns (and partly during the operation) of the nuclear power plant, as well as the preceding preservice examinations.

The inservice inspection program, which is submitted to STUK for approval, is a compilation of documents concerning the inservice inspections at the nuclear power plant and it comprises

- a summary program,
- a program for the preservice examinations, and
- programs for individual inservice inspections.

The summary program and the preservice examination

program, with associated inspections, shall be approved before the commissioning of the nuclear power plant (section 6.6).

The program for an individual inservice inspection is submitted to STUK for approval not later than one month before the planned date of inspection.

A summary of the inservice inspections is one prerequisite for placing the nuclear power plant back in service after a shutdown. Detailed descriptions of the inspections carried out are presented to STUK on request.

Summary reports of the results of the inspections are submitted to STUK for approval within three months after the inspections have been completed.

Irrespective of the safety class, the inservice inspections can be supplemented with non-destructive tests with special methods if they are considered necessary in order to ensure the reliability and integrity of the pressure vessel (for example stress corrosion tests).

The company and the testing personnel performing inservice inspections shall be approved by STUK in accordance with Guide YVL 1.3.

8.2 Supervision of outages

During the operation of nuclear facilities, STUK supervises outages for maintenance, repairs and refuelling. With respect to pressure vessels, STUK performs inspections that concern both administrative procedures and individual work performances in accordance with Guide YVL 1.13.

8.2.1 General licenses and descriptions of outages

General description of an outage

The general description of an outage, which is submitted to STUK for information, is supplemented with a work list showing the following work performances concerning pressure vessels:

- inservice inspections of pressure vessels
- inservice inspections as per Guide YVL 3.8
- performance tests of safety valves
- maintenance work
- repairs and modifications

Repairs, modifications and maintenance

The applications for general licenses concerning repairs, modifications and maintenance are submitted to STUK according to Guide YVL 1.8.

Restarting the plant after an outage

Restarting the plant after an outage requires a decision issued by STUK. The application that is sent to STUK shall indicate the significant issues and deviations revealed by the inspections during the outage.

In addition, the application contains the following information

- information on the unfinished work and tests that affect the start-up, and
- a summary of the inspections as per Guide YVL 3.8

When necessary, the application can be supplemented before the end of the outage.

8.2.2 Supervision and inspections

During refuelling outages and other similar extensive shutdowns, STUK supervises the periodic inspections and tests of systems and pressure vessels, the maintenance, repairs and modifications of components, and conducts inspections in relation to these activities.

The Finnish Centre for Radiation and Nuclear Safety supervises the mounting of the reactor pressure vessel internals and the closing of its head.

The closing of the reactor pressure vessel head can be commenced after the record concerning the reactor pressure vessel has been provided with a positive conclusion. In inspecting the reactor vessel, attention shall be paid to factors detected in the inspections of the vessel and its internals, as well as to any other matters affecting the closing of the head.

Before issuing the permit to restart the reactor, STUK ascertains that all the work in the work list and the pertinent inspections have been acceptably completed.

8.3 Inspections of repairs and modifications during operation

Inspections are performed if the pressure vessel has been repaired or modified or if there have been changes in its operating parameters or operating procedures.

If the structure of the pressure vessel is to be modified or repaired, the construction plan for the modification or repair must be submitted for approval in the same way as in the case of a new pressure vessel. An inspector of

STUK is entitled to accept plans concerning minor repairs and modifications.

The repairs and modifications, as well as their inspections, shall be recorded in proper documents.

Spare parts and replacements must be inspected in the same way as the parts that they will replace.

Individual documents concerning repairs, modifications and maintenance are submitted to STUK for approval in accordance with Guide YVL 1.8.

8.4 Reporting damages

If a pressure vessel is damaged, the supervisor of operation shall immediately notify STUK thereof (Guide YVL 1.5). In case of damage to persons or to the environment, the police shall also be informed. STUK performs the necessary investigation of the damage without delay.

8.5 Decommissioning and re-commissioning

The regulations on inservice inspections presented in section 8.1 are not applied to a pressure vessel if it has been confirmed in writing that the vessel has been decommissioned. If a pressure vessel has been out of service for more than a year, it cannot be placed back in service without an inspection of operation. The inspection of operation is also compulsory if the pressure vessel is moved to another place. The pressure vessel cannot be moved without STUK's approval. In the above cases the inspector can extend the inspection to encompass an inspection of the inside and a pressure test or some other test.

A pressure vessel that has been repaired after a damage shall undergo an overall inspection before it is placed back in service, unless the inspector decides that some other means are sufficient for determining the effects of the repair on the safe operation of the pressure vessel.

9 BIBLIOGRAPHY

9.1 Acts and decrees (with amendments)

| | |
|--------|----------------------------|
| 98/73 | Act on Pressure Vessels |
| 549/73 | Decree on Pressure Vessels |
| 356/57 | Atomic Energy Act |
| 75/77 | Atomic Energy Decree |

9.2 Guides issued by the Finnish Centre for Radiation and Nuclear Safety

- YVL 1.0 Safety criteria for design of nuclear power plants
- YVL 1.1 The Institute of Radiation Protection as the supervising authority of nuclear power plants
- YVL 1.2 Formal requirements for the documents to be submitted to the Institute of Radiation Protection
- YVL 1.3 Mechanical components and structures of nuclear power plants. Inspection licenses
- YVL 1.4 Quality assurance program for nuclear power plants
- YVL 1.5 Reporting nuclear power plant operation to the Institute of Radiation Protection

- YVL 1.8 Supervision of repairs and modifications on nuclear power plants during operation
- YVL 1.13 Supervision of shutdowns at nuclear power plants
- YVL 1.15 Mechanical components and structures in nuclear installations, Construction inspection
- YVL 2.1 Safety classification of nuclear power plant systems, structures and components
- YVL 2.4 Over-pressure protection and pressure control during disturbances in the primary circuit and steam generators of a PWR plant
- YVL 2.5 Preoperational and start-up testing of nuclear power plants
- YVL 3.1 Nuclear power plant pressure vessels. Construction plan. Safety classes 1 and 2
- YVL 3.2 Nuclear power plant pressure vessels. Construction plan. Safety class 3 and class EYT
- YVL 3.3 Supervision of the piping of nuclear facilities
- YVL 3.4 Nuclear power plant pressure vessels. Manufacturing license
- YVL 3.5 Nuclear power plant pressure vessels. Stress analysis. Draft
- YVL 3.6 Mechanical components of nuclear facilities. Supervision of manufacture

YVL 3.7 Start-up inspection of nuclear power plant pressure vessels

YVL 3.8 Nuclear power plant pressure vessels. Inservice inspections

YVL 3.9 Nuclear power plant pressure vessels. Construction and welding filler materials

9.3 Pressure vessel standards

SFS 2218 Welding. Qualification of welders

SFS 2223 Welding of pressure vessels. General rules for fabrication

SFS 2610 Design of pressure vessels. Basic requirements

SFS 3270 Inspection of pressure vessels. Construction inspection

SFS 3321 Inspection of pressure vessels. Pressure test

SFS 3323 Arrangements, equipment and operation of pressure vessels. Piping system

SFS 3333 Pressure containers. Arrangements, equipment and operation

SFS 3334 Inspection of pressure vessels. Inspection of pressure vessel other than steam boiler or piping.

In the event of any differences in interpretation of this guide, the Finnish version shall take precedence over this translation.